(12) UK Patent Application (19) GB (11) 2 222 000 (13) A

(43) Date of A publication 21.02.1990

(21) Application No 8814880.4

(22) Date of filing 22.06.1988

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(51) INT CL⁴
G02B 5/32, G03H 1/10

(52) UK CL (Edition J)
G2X XB20B
F4W W57
G2J J33B1

(56) Documents cited
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WO 82/04327 A US 4336978 A US 3708217 A

(58) Field of search
UK CL (Edition J) G2J J33B1, G2X XB20B
INT CL⁴ G02B, G03B, G03H

(54) **Optical component used for flame effect in heating apparatus**

(57) The optical component (21) is a transparent substrate having an interference pattern recorded thereon as a result of exposure to interfering beams (22, 23) of coherent light, one of which has a diffuse component and the other is modulated in intensity. The angle and amount of diffraction can be controlled by varying the angle of incidence of the interfering beams (22, 23) and this, together with a diffusion effect, is used to provide a flame effect in a heating apparatus. Preferably, such apparatus (1) comprises a rear reflector (16), an optical component (21), simulated fuel (13) and a moving light source (10, 11). Only a given angular cone of incident light on the optical component (21) is diffracted and the diffracted light, which appears diffuse, is reflected (16) outwardly of the heating apparatus. Component 21 is substantially transparent to the reflected light because it is not incident over the predetermined angular range for causing diffraction. A flame effect is thereby perceived between the simulated fuel (13) and its reflected image, i.e. in the middle of an extensive fuel bed.

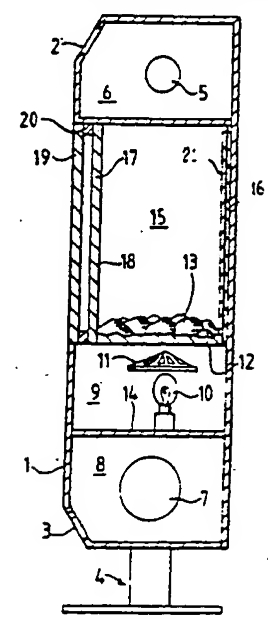

FIG.2.

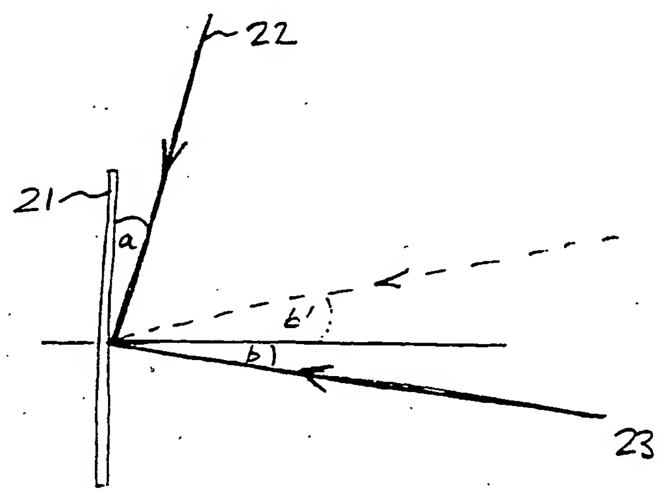

Fig 3a.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

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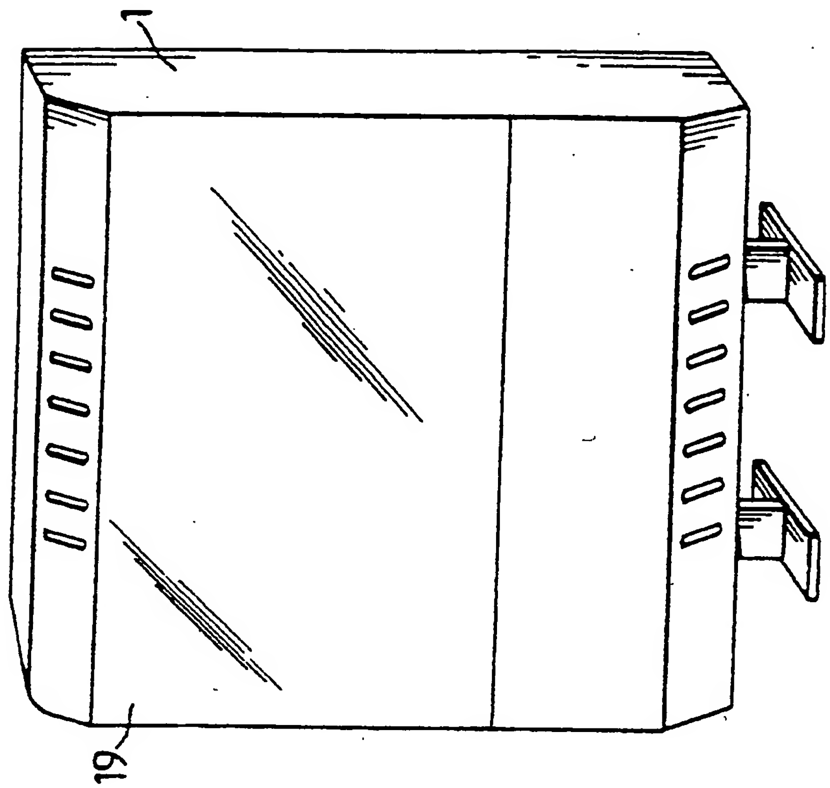

FIG.1b.

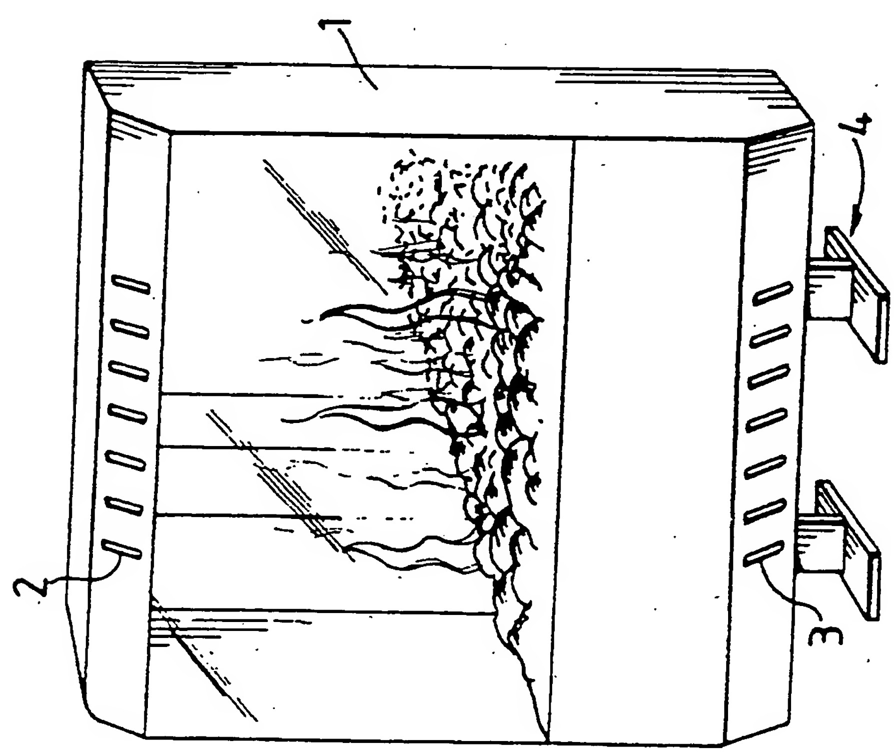

FIG.1a.

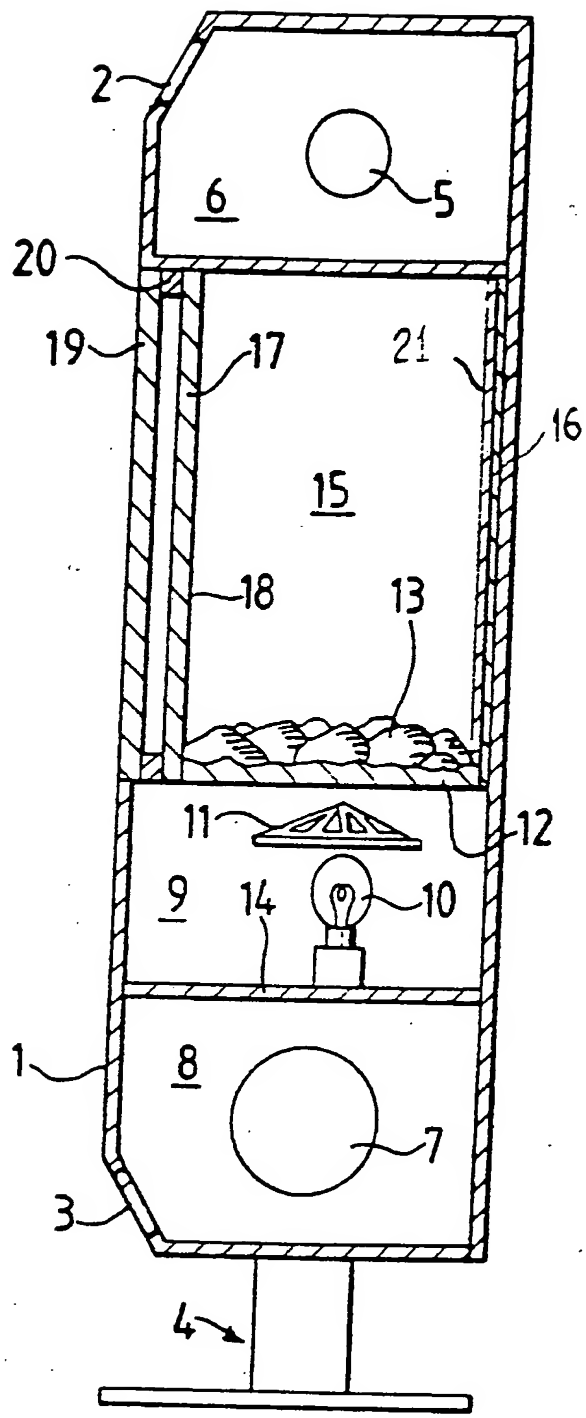

FIG.2.

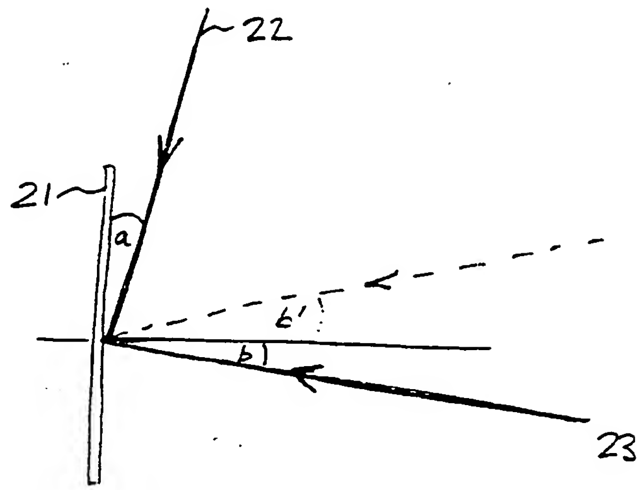

FIG 3a.

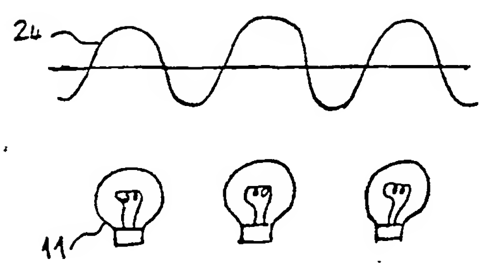

FIG. 3b.

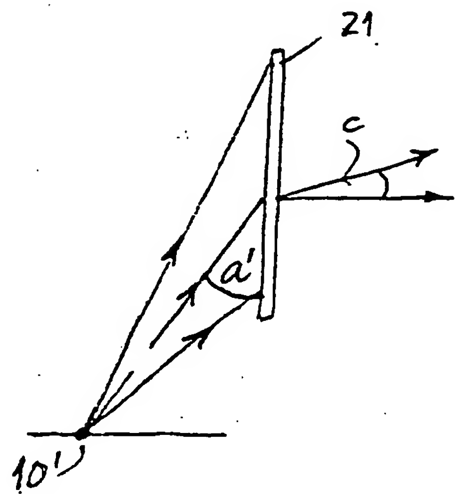

FIG 3c.

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OPTICAL COMPONENT, DISPLAY AND HEATING APPARATUS

This invention relates to an optical component for diffracting light having a predetermined angle or range of angles of incidence. It may be used, preferably with a mirror, to provide an optical display useful either on its own, or in heating apparatus for providing a decorative effect or for simulating combusting fuel. Such heating apparatus may include any means for producing a thermal output, for example, a radiant heater and/or convector and/or a fan heater powered by electricity, gas, or any other means and the apparatus may be, for example, free-standing, mounted on a surround, wall-mounted or provided in any other form.

Conventional means for simulating combusting fuel typically include the following components. A semi-translucent cover in the form of a plastics moulding shaped and decorated to resemble pieces of fuel, a housing on which the cover is mounted, a red or orange tinted electric light bulb within the housing and a light circular, multi-blade fan centrally mounted on a pivot pin above the bulb. The fan rotates due to thermal convection currents generated by the heat of the bulb and this provides a flickering effect which simulates, in a crude way, a glowing coal or log fire. However, such conventional means have at least the following disadvantages. The simulation of burning fuel is not really convincing. Dirt and dust can build up on the cover, e.g., due to local convection currents, and this considerably diminishes any realism. The plastics cover can also be seen to be a very poor imitation of simulated burning fuel when the appliance is switched off and it is incongruous in warmer weather when the fire is not required.

Our GB Patent No. 2180927 describes heating apparatus comprising means for providing an improved "fire effect" and this apparatus largely counteracts such

problems. The apparatus comprises means for providing a thermal output, means for simulating fuel, a light source for illuminating the simulated fuel and first and second reflective means arranged to provide front-to-back multiple images of the simulated fuel. The first reflective means is capable of transmitting light as well as reflecting light and the means for simulating fuel is provided between the first and second reflective means. The reflective means are arranged so that the multiple images can be perceived as a visible effect from the exterior of the heating apparatus. This arrangement has several advantages. For example, it creates a kind of "tunnel" imaging effect giving the impression of a deep or extensive fuel bed and this is particularly useful in creating more realism in "slim-line" designs of electrical heaters. The first reflective means, which is part reflective and part transmissive, also protects the means for producing the "fire effect" and thereby prevents the ingress of dirt and dust. Morever, the means for simulating fuel is less noticeable when the light source is switched off and it is substantially obscured when a cover plate is used which is made of, for example, a tinted transparent material such as "smoked glass". The visual effect of burning fuel is therefore not seen when it is not required.

Despite the advantages of the latter arrangement, even more realism is desirable, particularly where this can be achieved without imposing too many constraints on the design or cost of the heating apparatus.

GB 2151772 discloses a flame effect display which includes a hologram which, when illuminated, provides a holographic image of flames, means also being provided for varying the illumination of the hologram to create an effect of flame movement.

Whilst a holographic display may create a more realistic flame display, it has several drawbacks. For example, some holograms are of the kind which, when illuminated by ordinary light, suffer from image cut-off when viewed at certain angles. This can create a severe design problem when considering how a user of a heating appliance may "see" the holographic display. For example, the holographic display may be installed at the back of, and within a ground level electric fire and it may be difficult, or impossible for an observer, who is standing, or sitting close to the fire, or positioned at certain angle to see the holographic display. Moreover, the holographic flames may not be seen as a convincing part of the simulated burning fuel but rather as a separate display. The fact that the holographic display is an image of a model of flames also detracts from realism.

Some other holograms are of a kind which are illuminated by coherent light and these could produce other visible results. However, their use in a domestic electric fire would be impractical for reasons of cost and complexity.

GB 2151772 also mentions the use of switched lamps and colour filters for varying the illumination of the hologram. This would clearly add to the complexity and cost of the installation, as well as increasing the risk of mulfunction.

Other earlier prior art attempts to produce more realism (which do not use holograms) have employed translucent screens onto which light is cast in the manner of back-lit image projection. Examples of this are to be found in GB 1457540 and 1024047 and 295110. In GB 1457540, a bulb (8) and means for simulating fuel are situated behind a translucent screen (2). Light from the

bulb (8) illuminates a clear plastics sheet (11) on which dark areas, simulating lumps of coal, are painted; a reflector (5) provides back lighting. This arrangement casts lit areas and shadows onto the rear of the screen. In GB 1024047, a translucent screen (5), made by abrading a clear plastics sheets with a multiplicity of closely-adjacent thin horizontal lines, is positioned part way over a sheet of plastics (7) which is shaped to resemble fuel; an inclined reflector (6) is positioned behind the screen. In this arrangement, some of the light from a bulb (3) is reflected onto the back of the screen - as in the previous arrangement - and the remainder passes directly through the simulated fuel. The opacity of the screen is reduced in places, but this is only to make the simulated fuel visible behind the screen. In both GB 1457540 and 1024047 the translucent screens obscure light and hence severely limit any realism of the "fire effect".

In GB 295,110, a sharply inclined and curved reflector 11 is positioned at the rear of simulated fuel bed (13) and one or more part transparent/part translucent sheets (15, 16, 17) are spaced apart on the fuel bed. This reference teaches only the production of such sheets by darkening a portion of a glass sheet in a suitable way, for instance by a chemical process or smoking. This arrangement appears to depend on light being transmitted directly through the transparent areas to simulate flames and light illuminating the rear of the darkened portions to simulate smoke. It therefore produces only a crude "fire effect" and the sharp inclination of the reflector severely limits the viewing angle of reflected light by an observer.

One aspect of the present invention seeks to overcome these problems and to provide and enhanced

"decorative or fire effect" whilst avoiding complexity and/or high manufacturing costs. A particular problem to be solved is to produce an optical component which is substantially transparent, whereby light from a rear reflector can be seen as clearly as possible, and which at the same time deflects incident light in such a way as to optimise a viewer's field of view.

In accordance with one aspect of the invention, an optical display comprises a light source, means for reflecting light and diffracting means adjacent said reflecting means; said diffracting means being substantially transparent but having the property of diffraction as well as the effect of diffusion for light which is incident, from said source, over a predetermined angular range, the arrangement being such that light incident on the diffracting means over said range is first diffracted and then reflected back by said reflecting means through the diffracting means, the diffracting means being substantially transparent to the reflected light, so that said reflected light can be perceived as an optical effect from the exterior of the display.

Such a display can be used in heating apparatus or apparatus for simulating a fire effect, either of which include means for simulating fuel whereby a simulated fire effect can be perceived as a simulated combustion effect from the exterior of the heating apparatus.

Suitably, the source of light creates moving beams of light so that the angle of incidence of the light falling on the diffuse diffractive means is caused to vary and to pass through the predetermined angular range. This movement creates a flickering effect, simulating flames, thereby adding to realism.

Whilst the above aspect of the invention has been presented first to facilitate understanding, it should be appreciated that the invention has wider applications. In this regard, the invention generally provides diffracting means in the form of a transparent substrate on which an interference pattern has been photographically recorded by exposing a photographic medium on the substrate to optical interference and by subsequently processing the exposed medium, said interference pattern having the property of diffracting light as well as the effect of diffusing light which is incident over a predetermined angular range.

Preferably, the substrate is a transparent sheet, such as a film or plate, having a high resolution photographic emulsion thereon. Film used for producing holograms is suitable (although the diffraction means should not be regarded as a hologram since it does not reproduce an image of a subject, e.g. such as a model of a flame).

A method of producing such diffracting means comprises the steps of:

providing a transparent substrate on which there is a photographic emulsion having a sufficiently high resolution to reproduce a interference pattern which has the property of diffracting light;

exposing said substrate to interfering beams of coherent light which produce said pattern, the intensity of one of said beams varying in amplitude in a direction transverse to the plane of the substrate and a second one of said beams having at least a diffuse component; and

processing the exposed substrate to provide said pattern.

In a preferred embodiment, where the diffracting means is produced for use in the heating apparatus or fire effect display mentioned above, the beams are modified in order to enhance the flame effect. For example, the apparatus may comprise a plurality of moving light sources, such as a plurality of bulbs each provided with a pivotally mounted spinner having a plurality of radial reflective vanes. The spinners rotate, due to the thermal air currents produced by the bulbs, and thereby intercept the source light. This produces moving beams of light that can be intercepted and scattered by the means for simulating fuel, e.g., lumps of tinted glass. Various beams of scattered light will then sweep across the front of the diffracting means over a wide range of incident angles, including the narrower range which is intended to be diffracted.

With such an arrangement in mind, but not limited by reference thereto, the above method of producing the diffracting means may include the steps of varying the intensity of the first beam in a manner consistent with the positions of the light sources, e.g. the amplitude is caused to vary so that peaks occurs at these positions. The amplitudes of the peaks may be adjusted together or independently to vary the height of the 'flames' and in some cases also to produce a hazy 'smoke' effect. The intensity of a component of the second beam may be similarly varied to enhance the 'flame effect' and such a beam further includes the diffuse component. The angle of incidence of the beams on the substrate may also be varied, or predetermined to control the brightness of the 'flame effect'. The angle of the second beam may be further varied or predetermined to control the vertical viewing position of the 'flame effect' (i.e. by changing the angle of diffraction).

An incident ray of light diffracted by the diffracting means leaves the latter within a certain solid cone thereby simulating a diffusion effect. When considering a multiplicity of such incident rays, the emergent light will be in the form of a multiplicity of adjacent overlapping solid cones and this supplements the diffusion effect. For optimum brightness, the angle of incidence between the first beam and the substrate (when making the diffusing means) and the angle of the emergent cone of light made with a normal to the substrate (when the diffusing means are used) are made approximately the same. However, the angle of incidence of the first beam (when making) may be substantially the same as the angle of incidence of the light to be diffracted (when using) for maximum brightness. More particularly, these incident angles may be in a range from about 15° to the Brewster angle and preferably around 20°.

Whilst the diffracting means is preferably used together with reflective means to provide a simulated 'flame effect', the reflective means is not required where light need only be diffracted. For example, the diffracting means (in the form of a film or sheet) could be positioned at the front of a fire in order to view diffracted light directly. However, this is not normally preferred because the 'flame effect' would not then appear to hover over the simulated fuel. In the preferred case, the diffracting means is situated closely adjacent or in contact with the surface of the reflective means for providing diffracted and reflected 'flame' images at a region which appears to lie between the actual simulated fuel and its reflected image. Thus, an impression is created of a moving flame in the middle of an extensive fuel bed. (Since the diffracting means is substantially

transparent, it does not obstruct the perception of an image of the simulated fuel in the reflective means which is why the observer has the impression of an extensive fuel bed.) Moreover, when the diffracting means is situated behind the simulated fuel and close to the reflective means, there are no confusing reflections of stray or background light. This would be the case, for example, in the arrangement shown in GB 295110 where intermediate glass sheets are positioned on top of the simulated fuel at widely spaced points between the front sheet and the rear reflector.

Sheet material produced by, or used in accordance with the invention, may be coated to reduce or eliminate specular reflection.

In heating apparatus according to a preferred embodiment of the invention, the reflective means for imaging the simulated fuel is a reflective sheet positioned in a substantially vertical plane at the rear of the heating apparatus, the diffracting means is situated closely adjacent or in contact with the reflected sheet, means for simulating fuel is located in front of the lower edge of this sheet, and means for producing moving beams of light is located beneath the simulated fuel. With this arrangement, a surprisingly effective flame effect is generated when the diffracting means, e.g. in sheet form, is simply placed immediately in front of the rear reflective sheet.

If a transparent sheet having the property of diffraction and the effect of diffusion is produced by treating one of its major surfaces, the treated surface may face either outwardly, or inwardly from the rear reflector.

Whilst a rear reflective sheet may provide support to hold a diffracting sheet in place, the latter is preferably caused to adhere to the former. This makes assembly very easy, for example, diffracting sheets may be produced which are self-adhesive. Moreover, by using such sheets, a heating appliance of the kind described in our GB Patent No. 2180927 can be quickly converted into one having a flame effect. Different and/or replacement sheets could also be made available to the user, e.g., for changing the effect by using sheets with different patterns and/or colours, or for simply replacing an original sheet.

Other advantageous optical effects may be created by including additional reflective means to enable front-to-back multiple images of the simulated fuel to be perceived from the exterior of the heating apparatus. Such an effect is described in more detail in our GB Patent No. 2180927 and it will be understood that the various features of the heating apparatus disclosed therein may be used either singly, or in any combination, to enhance the visual effects created by this invention.

A preferred embodiment of the invention will now be described with reference to the accompanying schematic drawings, in which:

Fig. 1 is a perspective view of an electrical radiant/convector heater which incorporates means for providing a "fire effect",

Fig. 2 is a side elevation, partly in section and on a larger scale, of the heater shown in Fig. 1, and

Fig. 3 schematically illustrates different optical paths which facilitate an understanding of the principle involved in the preferred embodiment.

Whilst the preferred embodiment will be described with reference to an electrical convector/fan heater, it will be understood that the invention can be applied to other types of heating apparatus including those which employ means other than electricity for providing a thermal output or to simply a display which may create, for example, the impression of a fire.

The heater shown in the drawings includes an outer casing 1 having ventilation holes 2, 3 and standing on legs 4. Fig. 2 schematically illustrates a convector element 5 located in an upper chamber 6 of casing 1. Similarly, a fan heater 7 is located in a lower chamber 8. A chamber 9 contains a tinted bulb 10 and a thermally driven, circular fan or spinner 11. Only one bulb and fan are shown for ease of illustration but (e.g.) two, three or four may be used depending on the width of the heater and the effect required. The circular fan 11 is centrally pivoted (by means not shown, but of known construction) so that it rotates due to the thermal currents of air produced by the bulb 10 when illuminated. The bulb 10 is preferably tinted red or orange whereby beams of tinted light, intercepted by the blades of the fan 11, are directed upwardly towards a transparent, or translucent plate 12. Sheet 12 supports pieces of tinted glass 13 having irregular shapes and intended to resemble glowing pieces of coal. (Other arrangements are possible, e.g. where ordinary bulbs are used and sheet 12 is tinted.) Sheet 12 preferably has an uneven surface, e.g., it may be a sheet of 'patterned glass'. In alternative arrangement (not shown), the sheet 12 and the simulated pieces of fuel 13 are made as an integral structure, e.g., in the form of

a moulded sheet which simulates a bed of fuel and which is at least partially light-transmissive. The front, rear and sides of the chamber 9 are formed by part of the casing 1 which thereby obscure light from bulb 10. The floor 14 of chamber 9 may be either opaque, or it may transmit some light downwardly into chamber 8 whereby a red or orange glow can be seen through the ventilation holes 3.

A chamber 15, which is largely empty except for the pieces of glass 13, is situated between chambers 6 and 9. A sheet 16 of polished or plated metal, such as aluminium, is located at the rear of chamber 15 in order to reflect light towards a sheet 17 which is at least transparent and preferably partly transparent and partly reflective. Sheet 17 is preferably made of heat-resistant glass with a partially-reflective coating 18 on its inner major surface. Sheets 16 and 17 are substantially parallel whereby multiple images of the simulated fuel 13 may be observed from the exterior of the heater through a transparent cover plate 19. Where multiple images are not required, sheet 17 may be omitted so that the observer will then see only one image of the simulated fuel 13 (in reflector 16). The cover plate 19 is preferably made of heat-resistant, tinted plastics material which resembles so-called "smoked glass". For example, sheet 19 may be tinted grey or brown or other colours so that it appears to be transparent when chamber 15 is illuminated with light from bulb 10 (see Fig. 1a), and so that it appears to be opaque when bulb 10 is off (see Fig. 1b). The sheet 19 is spaced from sheet 17 by means of a frame 20. The front surface of sheet 19 is preferably flush with the front surfaces of casing 1 so as to provide a pleasing smooth finish to the front of the heater, especially when

chamber 15 is not illuminated (see Fig. 1b). The sheet 19 may be just transparent, i.e. not tinted, where the latter effect is not considered to be important.

A substantially transparent diffracting sheet 21 is situated close to, and preferably in contact with the rear reflector 16. Suitably sheet 21 is self-adhesive and is thereby attached to reflector 16. In view of the fine nature of the interference pattern recorded on sheet 21 and its basic transparency, it is not practical to attempt to show an illustration of the recorded surface. However, a description will be given below of a preferred technique of manufacture.

The floor of chamber 6 may be opaque, or it may transmit some light which can be perceived, as a tinted glow, through ventilation holes 2.

When the light bulb 10 is switched on, thermal currents of air cause the fan 11 to rotate. Beams of tinted light, intercepted by the blades of fan 11, thereby pass upwardly through sheet 12 and through and/or between the simulated pieces of fuel 13 into chamber 15. These beams of light are incident on the front face of sheet 21 and beams of light within a certain solid cone of incident angles are diffracted, the diffracted light passing through sheet 21 and being incident on reflector 16. The diffracted light emerges within a solid cone (as explained with reference to Fig. 3c) and this provides the effect of diffusing the diffracted light. This light is then reflected by sheet 16 back through the diffracting sheet 21 and out through sheets 17 and 19. Since the angle of incidence of the reflected light on the diffracting sheet is not within the angular range of light which would be

diffracted, the diffracting sheet 21 appears to be transparent to the reflected light which thereby passes straight through and emerges, over a wider field of view than would otherwise be the case, and is perceived through the front cover plate 19 as a flame effect, i.e. the light simulates flickering flames. The realism of the effect is remarkable in view of placing just one sheet 21 at the back of the chamber 15 in contact with reflector 16. Moreover, since sheet 21 is between the simulated fuel and its reflection (in reflector 16), the simulated flames appear to emanate from the middle of an extensive fuel bed, thereby adding to the realism. This effect is multiplied when the part transparent and part reflective sheet 17 is used to produce multiple images. In this case, the eye-level of an observer standing in front of the heater is normally above the centre of sheets 18, 19 whereby a series of multiple images of the simulated fuel 11 are perceived through the cover plate 19. These multiple images are schematically illustrated in Fig. 1 and give the appearance of an even more extensive fuel bed stretching back far beyond the rear panel of the heater. This heightens the attractiveness and effect of a glowing fuel bed, especially where the heater is of the contemporary "slim-line" design.

As the chamber 15 can be totally enclosed, this prevents the build up of dirt and dust which would otherwise detract from the "fire effect". However, there may be applications where no front cover plate or plates are used (i.e. both plates 17 and 19 being omitted).

The bulb 10, which may be one of a plurality each located adjacent a respective fan 11, can be connected in series with a dimming switch (of known construction) for adjusting the level of illumination of chamber 15 to an

optimum value. Alternatively, a plurality of bulbs may be selectively switched on or off to achieve the same purpose. This is useful where the level of illumination of the "fire effect" may need to be adjusted to suit different levels of illumination of a room in which the heating apparatus is installed. The positions of the bulbs 10 may also be adjustable, if not predetermined, so that an optimum diffraction effect is achieved.

Reflectors may also be provided at the sides of the fuel bed to enhance the effect of a broad extent of burning fuel.

Referring to Fig. 3, sheet 21 is a high resolution photographic film which is exposed to two beams of light 22, 23 which are mutually coherent and which optically interfere on the surface of the sheet. Only ray paths are shown in the drawing since the beams would normally extend over the incident surface. The intensity 24 of beam 22 is caused to vary in a direction parallel to the positions of bulbs 10 as shown diagrammatically in Fig. 3b. The degree of 'amplitude modulation' can be varied to vary the height or size of the 'flames'. The intensity of beam 23 can be similarly varied to enhance the latter effect and beam 23 further includes a diffuse component. Beam 23 is thus a composite beam including one 'modulated' component and one diffuse component. Beam 22 makes an angle <u>a</u> with the surface of sheet 21 and beam 23 makes an angle <u>b</u> with a normal to this surface. Instead of being on the far side of the normal (as shown in Fig. 3a), beam 23 may be on the nearside of the normal (i.e. making an angle <u>b</u>') to improve the viewing angle. Angle <u>b</u> can be varied to change the vertical viewing position of the flame effect. For optimum brightness, angle <u>a</u> should be close to angle <u>c</u> (see Fig. 3c and the explanation below) but we have found

that maximum brightness can be achieved where angle a is substantially equal to angle a', e.g. over a range of from about 15° to the Brewster angle and preferably around 20°..

Following exposure to beams 22, 23 sheet 21 is processed in accordance with standard photographic techniques but is subjected to bleaching after immersion in a developer and a subsequent stop bath. This assists in maintaining transparency without substantial loss of the recorded pattern that provides the diffraction and the effect of diffusion. The recorded pattern can be fixed if necessary (since the bleach acts as a fixer) and then dried. An anti-reflection coating may be used, e.g. sprayed onto the dried sheet to reduce or eliminate specular reflection which could otherwise cause feint confusing images to be seen. However, this is a refinement since most of the unwanted light passes through sheet 21, without being diffracted, and is lost within the casing due to the angles at which it is reflected by rear reflector 16.

Fig. 3c schematically illustrates sheet 21 in an operative position where light from a source 10' illuminates the front surface of sheet 21 and is diffracted, as shown by the path of the middle ray, through the sheet. With the source 10' shown as a single point with a mean angle of incidence a' (angle a may be equal to or much greater than angle a'), the diffracted light passing through sheet 21 emerges over a solid angle c made to a normal to the surface of sheet 21. This light passes to the rear reflector 16 where it is reflected back through sheet 21 and out through sheets 17 and 19 to the observer. Since the light is 'bent' by diffraction, this improves the observer's field of view, i.e. compared with

the prior art arrangements mentioned above. Moreover, the angle of diffraction can be selected with the desired effect in mind, for example, a field of view stretching from just above floor level to an average height of eye of a standing or seated person.

Since the cone c represents the emergent light from one incident ray, it can be seen that a multiplicity of adjacent cones c representing emergent light from a multiplicity of incident rays would overlap one another. This supplements the effect of diffusion.

In practice, the light incident on sheet 21 is composed of many beams of light and only those beams within a certain controlled cone of incident angles are diffracted and then reflected out of the heater. This is an advantageous effect in that it substantially reduces undesirable stray light that would otherwise be perceived from the exterior of the heater as confusing reflections.

Repositioning the bulbs 10, modifying the angle of the vanes on the fans 11 and/or modifying the simulated fuel (12, 13) through which the light passes en route to sheet 21 will change the effect. Certain interference patterns may be used to cause selective diffraction to produce coloured effects and this may be enhanced by the use of white and/or coloured light (e.g. produced with the aid of filters).

Since the diffusing means can be advantageously used to provide bright images, the cover plate 19, i.e. which is preferably made of tinted transparent material, can be darker in order to obscure the means for simulating the fire effect when the heater is not used to produce a thermal output (e.g. during the summer).

It will be understood that the embodiments of the present invention which have been described above have been described by way of example only since modifications of detail could be made without departing from the scope of the invention.

CLAIMS:

1. An optical component capable of diffracting light, said component being provided in the form of a transparent substrate on which an interference pattern has been photographically recorded by exposing a photographic medium on the substrate to optical interference and by subsequently processing the exposed medium, said interference pattern having the property of diffracting light as well as the effect of diffusing light which is incident over a predetermined angular range.

2. An optical component according to Claim 1 wherein said substrate is a transparent sheet having a high resolution photographic emulsion thereon.

3. An optical display comprising a light source, means for reflecting light, and diffracting means adjacent said reflecting means; said diffracting means being substantially transparent but having the property of diffraction as well as the effect of diffusion for light which is incident, from said source, over a predetermined angular range, the arrangement being such that light incident on the diffracting means over said range is first diffracted and then reflected back by said reflecting means through the diffracting means, the diffracting means being substantially transparent to the reflected light, so that said reflected light can be perceived as an optical effect from the exterior of the display.

4. A display according to Claim 3 wherein said diffracting means comprises the component in accordance with Claim 1 or 2.

5. A display according to Claim 4 wherein said optical component is provided in sheet form.

6. A display according to Claim 5 wherein the sheet is adhesively attached to the reflecting means.

7. Heating apparatus or apparatus for simulating a fire effect comprising the optical display according to any of Claims 3-6.

8. Apparatus according to Claim 7 including means for simulating fuel whereby a simulated fire effect is perceived

from the exterior of the apparatus.

9. Apparatus according to Claim 8 wherein said light source comprises one or more electric bulbs provided with a fan which is driven by thermal convection currents and thereby intercepts light from the bulb, the position of said bulb or bulbs with respect to said diffracting means being such as to provide moving beams of light which pass through a given cone of incidence angles with respect to the diffracting means.

10. Apparatus according to Claim 8 or 9 wherein said reflective means comprises a reflective sheet positioned in a substantially vertical plane at the rear of the apparatus, said diffusing means is situated closely adjacent or in contact with said reflective sheet, said means for simulating fuel being located in front of a lower edge of the latter sheet and said light source being located beneath the simulated fuel.

11. Apparatus according to any of Claims 8-10 including additional reflective means to enable front-to-back multiple images of simulated fuel to be perceived from the exterior of the apparatus.

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